Engineering

CLASSIFYING SIGNALS: NON-LINEAR CLASSIFIER VS. LINEAR CLASSIFIER[1]

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ABSTRACT

The purpose of this research project is to measure the performance of a non-linear signal classification system on both linear and non-linear signals. The classifier developed by our project team at Marquette University uses reconstructed phase spaces, which are plots of a signal against time-delayed versions of itself. These reconstructed phase spaces are modeled statistically with a Gaussian Mixture Model to capture the signal's characteristics. The effectiveness of this non-linear classifier was compared to the effectiveness of a linear classifier based on prediction coefficients on two sets of experimental data, each run with several different levels of additive noise. In the first experiment, the classification task was to discriminate between a signal generated by a logistic map (a type of chaotic system) and its surrogate, which is a synthesized signal having the same Fourier Transform as the original signal. The non-linear classifier was able to distinguish between the logistic signal and its surrogate, while the linear classifier did only as well as chance. In the second experiment, linear signals were generated by passing white noise through two band pass filters, with pass bands overlapped by 50%. In this case, the non-linear classifier based on reconstructed phase spaces performs almost as well as the optimal linear classifier. These results demonstrate that the proposed non-linear classification system has substantially better performance than comparative linear methods on non-linear signals, with only a small degradation in the case of linear signals.

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